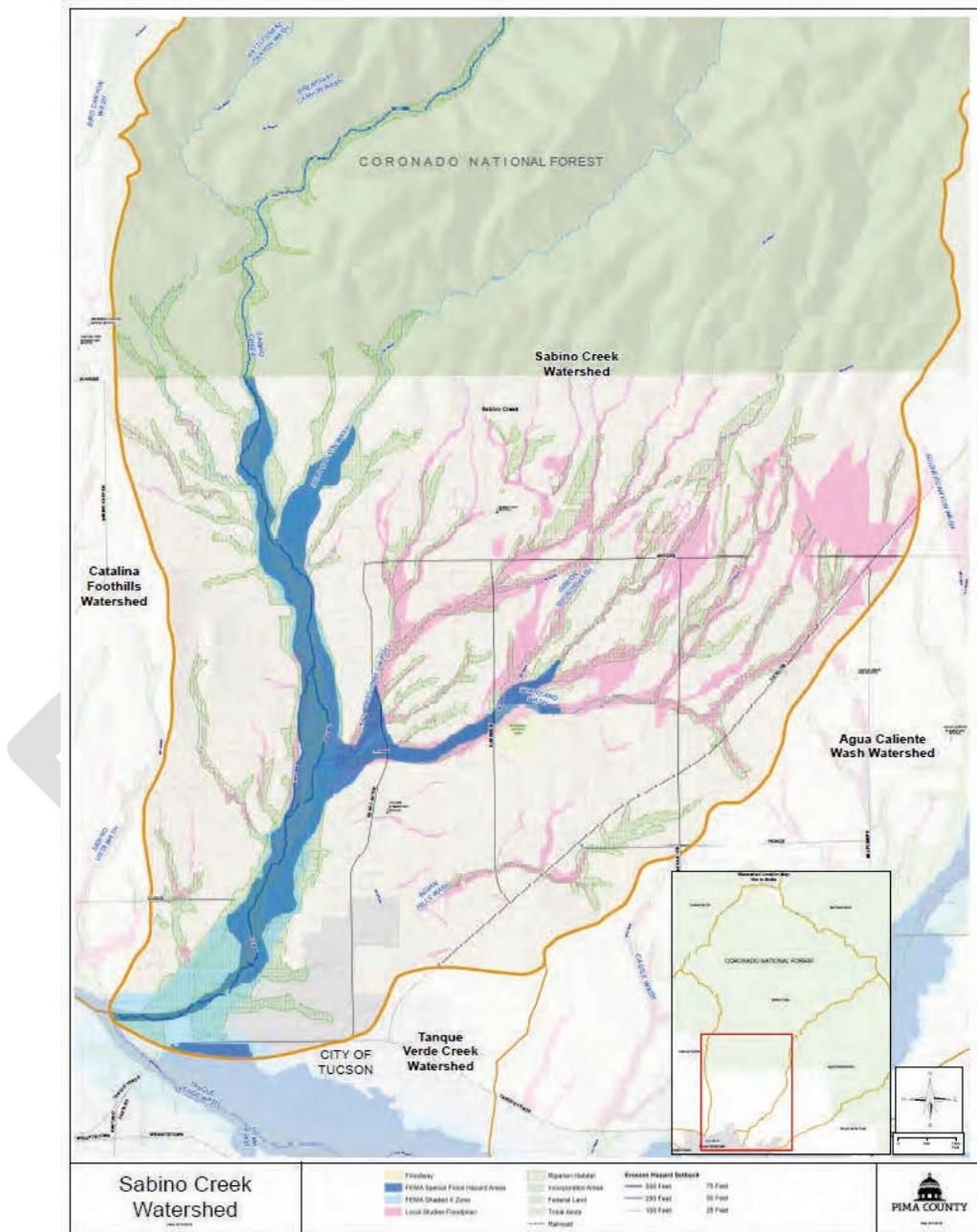


5.4.11 Sabino Creek

Sabino Creeks' origins are near the summit of Mount Lemmon and the community of Summerhaven. Originating at nearly 9000', it descends steeply through dramatic canyon walls before spilling out onto the bajada foothills and geologic floodplains associated with the Tanque Verde where they merge to become the Rillito Creek. Within Pima County, it is comprised of 140,539 acres (219.6 square miles).

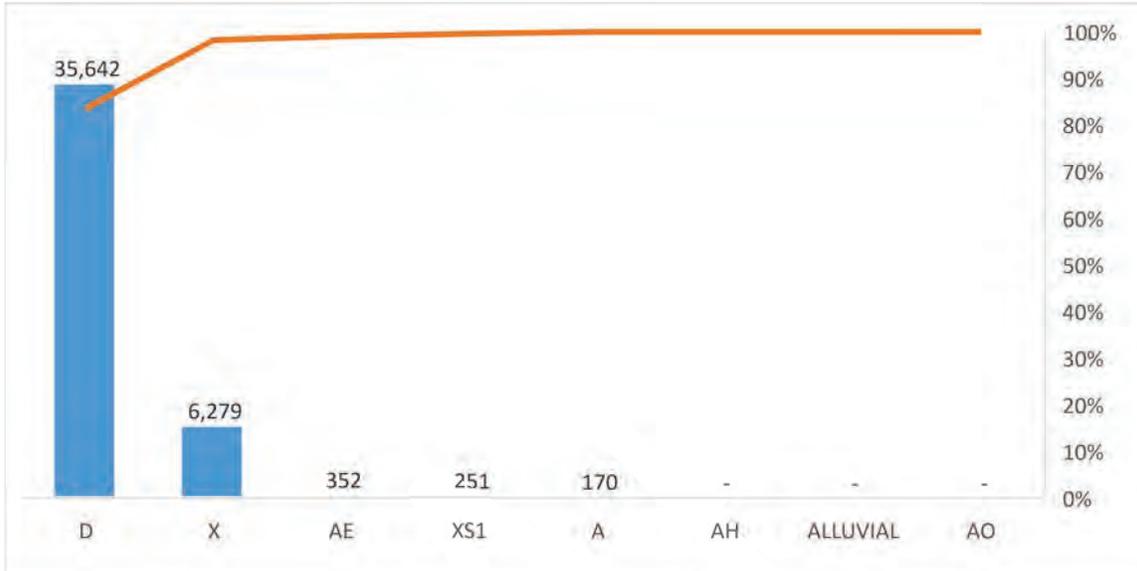
Figure 119 - Sabino Creek Watershed Map



5.4.11.1 Flood Characteristics

In addition to 522 acres of SFHA zones included on the bar chart below, there are also 844 acres of District Special Studies Floodplains in this watershed.

Figure 120 - Sabino Creek SFHA in Acres



Unlike most of Pima County flow, flow in these watersheds can continue for extended periods, and the upper watersheds may even experience perennial flow. Flow measurement in the Sabino Creek is more complete than many other watersheds. A summary of the USGS gaging station records is as follows:

Table 35 - Sabino Creek Watershed USGS Gages

USGS Gaging Station	USGS 09484000 SABINO CREEK NEAR TUCSON, AZ	USGS 09484200 BEAR CREEK NEAR TUCSON, ARIZ.
Period of Record	Jul. 1932 to Jan. 2015	Nov. 1960 to Dec. 1978
Watershed Area (sq. m)	35.5	16.3
Flood Peak of Record (cfs)	15,700	1,400
Date	31-Jul-06	18-Dec-78

These records indicate that floods in the Sabino Creek watershed can occur from all three of the three primary flood mechanisms that occur in Pima County, convective storms, tropical storms and frontal storms. Rain on snow events occur in this watershed when frontal storms produce rain on existing winter snow.

The table below summarizes Pima County’s Alert Gages. The locations are from the District’s Alert map.

Table 36 - Sabino Creek Watershed ALERT Streamflow Gages

Pima County Alert Gage	Sabino Creek near Marshall Gulch ID: 2293	Sabino Creek at USFS Dam ID:2163	Bear Creek ID: 2184
Location (Latitude, Longitude)	(32.42,-110.7519)	(32.3147,-110.8106)	
Period of Record	2003-07-17 to Present	1997-09-26 to Present	2018-06-29 to Present
Watershed Area (sq. m)	3.34	53.1	16.3
Flood Peak of Record (cfs)	355	13376	
Date	03-10-2012	07-31-2006	

Table 37 - Sabino Creek Watershed ALERT Precipitation Gages

Pima County Alert Gage	Sabino Canyon at Marshall Gulch ID: 2290	Al Marah ID: 2190	Bear Canyon Wash ID: 2180	Whitetail ID: 2150	Green Mountain ID: 2280	Sabino Creek ID 2160	Mt Lemmon ID: 1090
Location (Latitude, Longitude)	(32.2853,-110.5636)	(32.279969-110.802161)		(32.413105,-110.731905)	(32.394576,-110.687284)	(32.314635,-110.810856)	(32.44264,-110.788513)
Period of Record	2003-07-17 to Present	1994-08-06 to Present	1993-03-15 to Present	1986-08-27 to Present	1986-06-17 to Present	1987-07-02 to Present	1985-05-10 to Present

Below are excerpts for Sabino Creek and major tributaries from the District’s Table of Regulatory Discharges (Revised October 28, 2014).

Table 38 - Sabino Creek Watershed Regulatory Discharges

Watercourse	Regulatory Discharge, cfs 1% Return Frequency	Drainage Area, sq. miles	Source of Discharge Information
Agua Caliente Wash Upstream of confluence with Soldier Canyon Wash	12,000	28.60	FEMA Map Revision (11-09-1817S)

Flood characteristics vary greatly on the watershed. While flow is primarily constrained in mountainous channels, distributary flow patterns develop where these channels enter the valley floor at the apex of alluvial fans, and residential properties are at risk for flood damage where drainage infrastructure does not exist. Potential for overbank flow leading to flooding exists along the Sabino Creek, particularly at its confluence with Tanque Verde Creek.

Likewise, flood characteristics themselves vary greatly depending on whether the event is convective event, such as the July 31, 2006 event, which was produced by a high intensity, shorter duration event, or a rain on snow event, which can release a higher volume of water over a longer period. Tributary flooding is likely during short and long duration storms while main stem flooding typically occurs during long duration or overlapping storm events.

Sabino Creek enters the valley floor onto alluvial fans, which is where most of the development has occurred. Flows on these fans can cause erosion, deposition and channel avulsion. The July 31, 2006 also produced debris flows on these alluvial fans, which resulted in flooding of some structures that would not have been at risk if the debris flow had not altered the flow pattern at the apex in Soldier Canyon. In addition, even where flow-patterns were not altered, such as in Sabino Canyon upstream of Bear Canyon, the sediment released in the debris flow filled the channel and reduced the flood capacity.

As flows enter the valley floor in the main channel of Tanque Verde creek, flows are contained. Downstream of Sabino Creek the District has installed bank protection to limit the potential for channel migration.

5.4.11.2 Existing Development & Infrastructure Trends

The chart below shows the distribution of residents within known floodplains, and distribution between incorporated and unincorporated areas.

Figure 121 - Sabino Creek Watershed Population Distribution

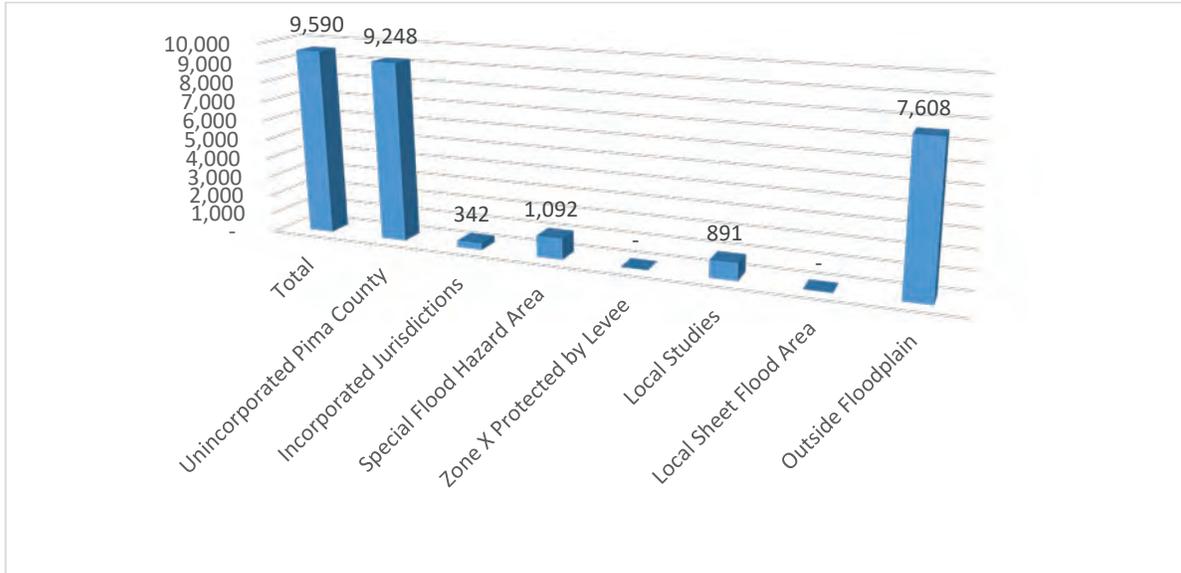
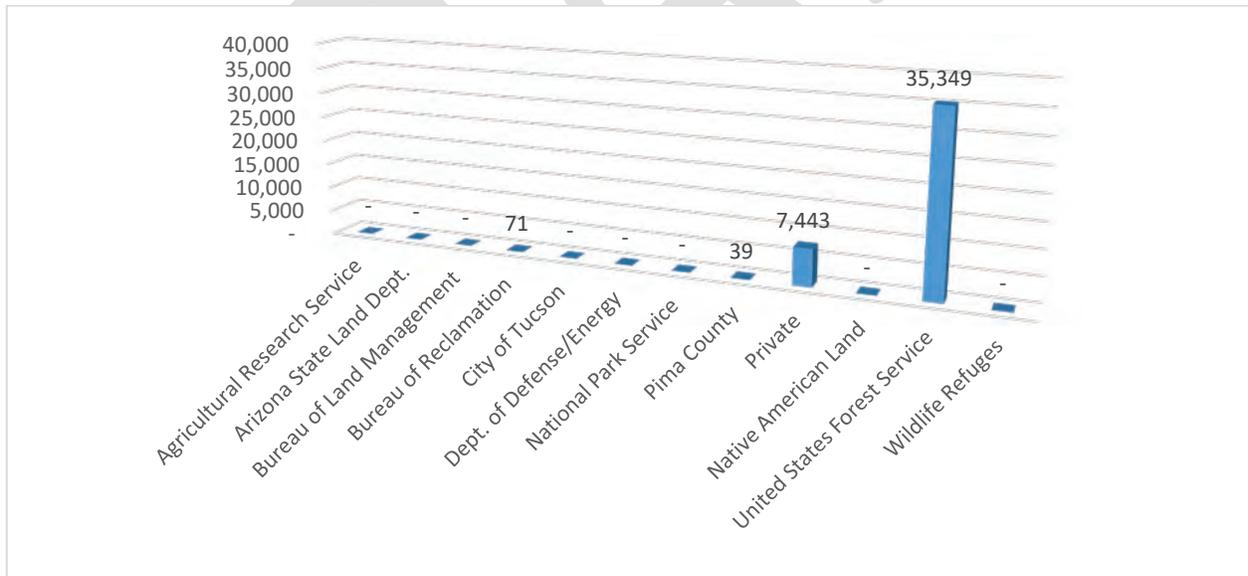
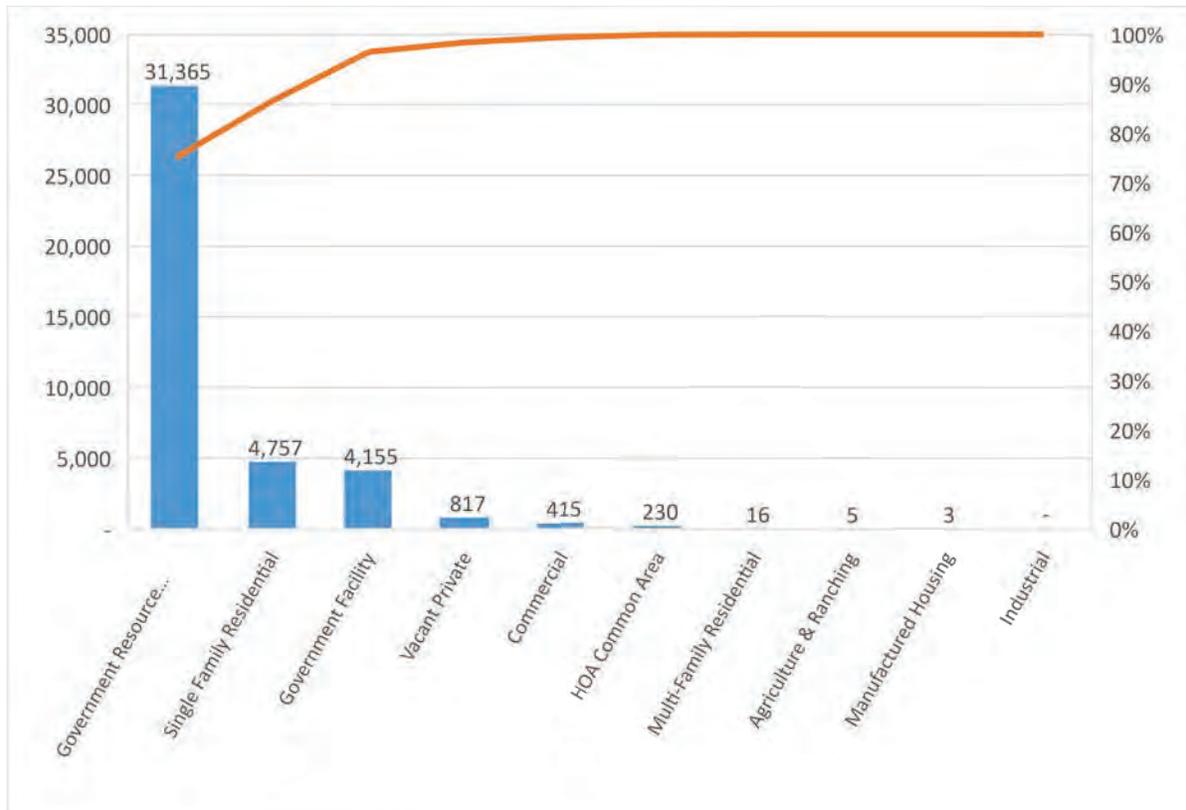


Figure 122 - Sabino Creek Watershed Ownership in Acres



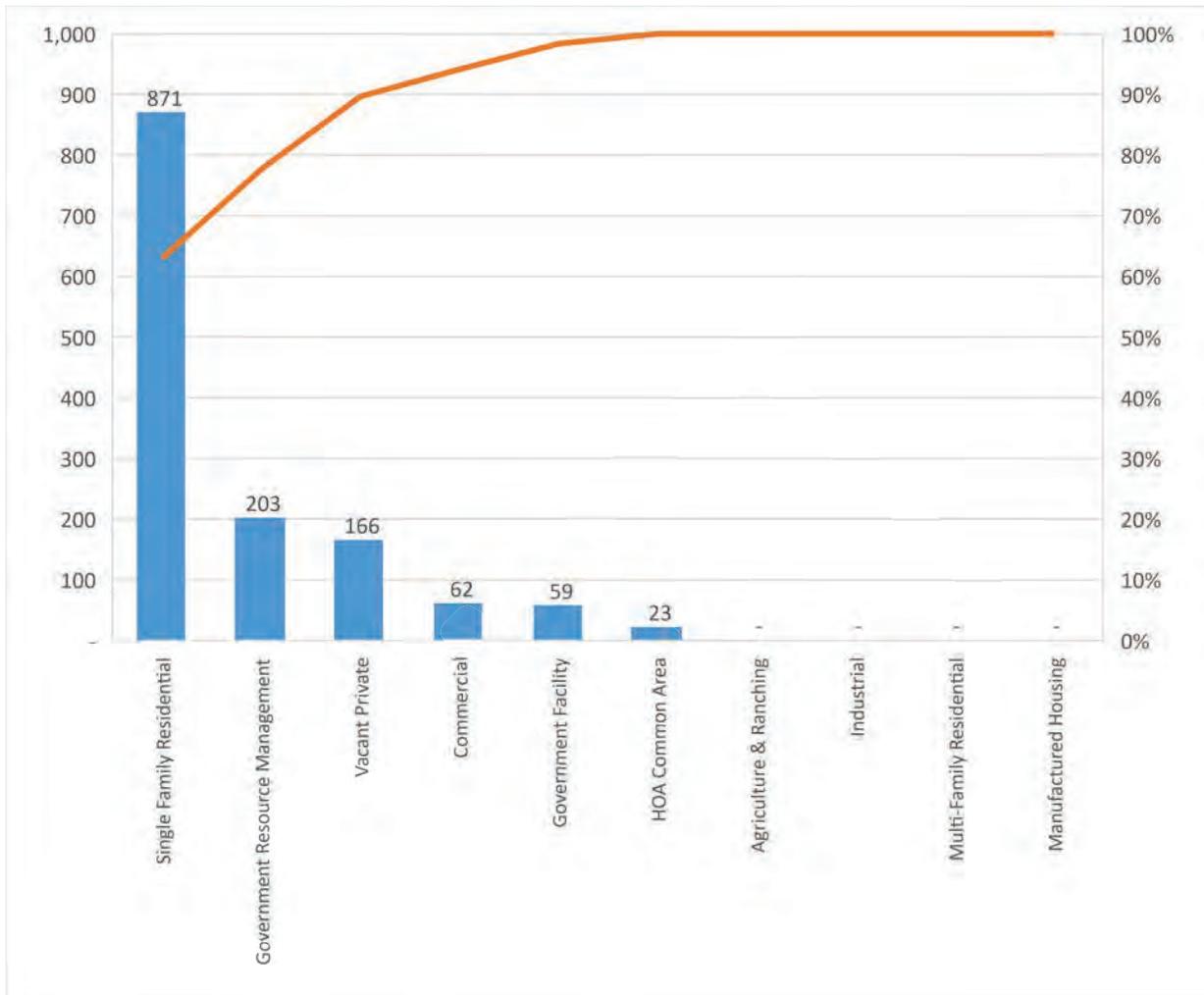
Single family residential is the predominant use throughout this watershed.

Figure 123 - Sabino Creek Watershed Land Use in Acres



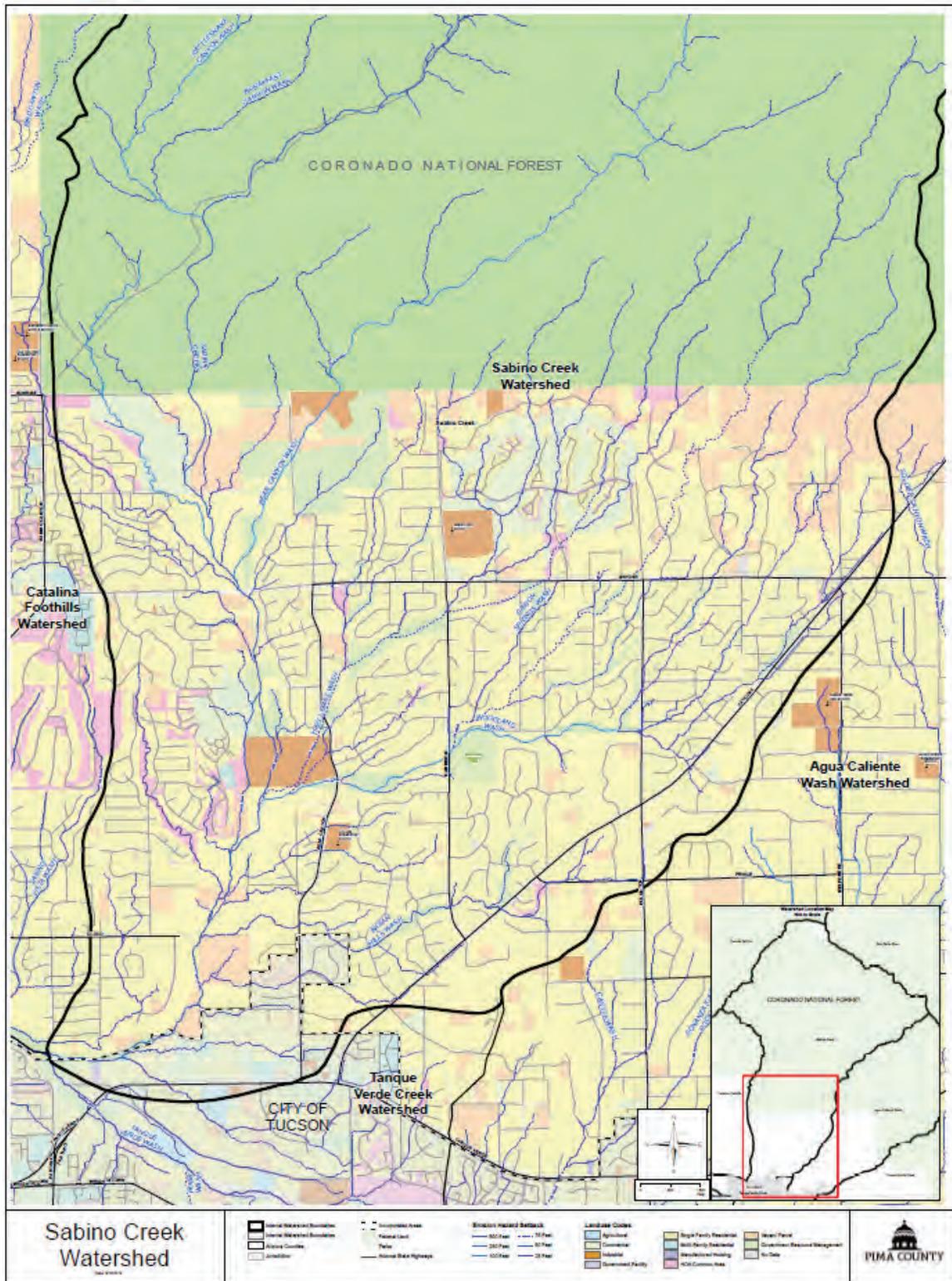
In recent years, the County has approved increased densities on areas previously left open due to flood and other limitations. While build out of improved developments and some lot splitting can be expected few large tracts are available for development. Furthermore, a leading local non-governmental organization, the Watershed Management Group has embarked on a campaign to restore perennial flows in Sabino Creek by working with willing landowners to install water-harvesting features, disconnecting impervious surfaces, groundwater withdrawal management and retiring wells.

Figure 124 - Sabino Creek Floodplain Land Use



As noted above for these watersheds as a whole single family residential is the largest use of private floodplain land. The map below shows these land use patterns.

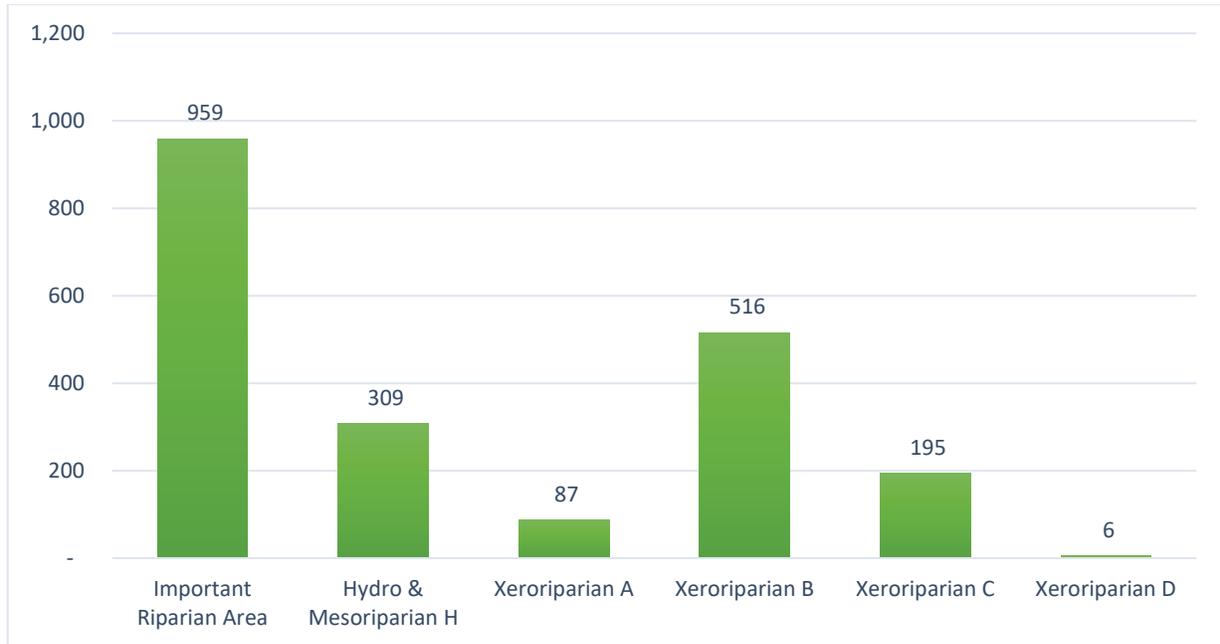
Figure 125 - Sabino Creek Watershed Land Use Map



5.4.11.3 Riparian Habitat and Natural Areas

As shown on the figure below, there are 1,112 acres of Pima County Regulated Riparian Habitat in this watershed; in addition, there is 959 acres of IRA. It is also interesting to note the quality of this habitat as reelected in the higher percentages of H, A and B. There are also 35,214 preserved acres in this watershed, including 68 in regulatory floodplain.

Figure 126 - Sabino Creek Watershed Riparian Habitat in Acres



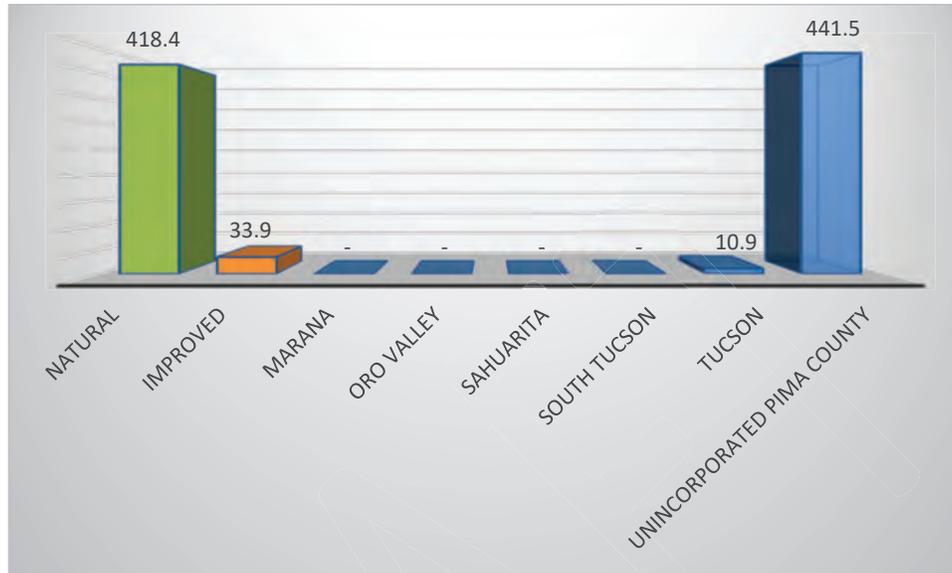
The confluence with the Rillito as well as the canyon headwaters contain some of the largest networks of springs, surface flows and shallow groundwater anywhere in the County. This water availability has contributed both to the biologic, historic and cultural significance of this region as well as current high property and recreational amenity values. Today, landowners and community groups including, Friends of Redington Pass, Watershed Management Group, Coalition for Sonoran Desert Protection and Audubon Society are pursuing preservation and enhancement of these values and they warrant the full measure of protection afforded by floodplain management practices.



5.4.11.4 Historic Floodplain Management Approach

The figure below shows the split between natural and improved drainageways, and how many acres the District is responsible for in each jurisdiction.

Figure 127 - Sabino Creek Drainageway Acreage



In 2010, the District began mapping tributaries to larger watercourses where typically FEMA mapping existed on the watercourse but not on the tributaries. Performing these studies at a level of detail suitable for floodplain management and permitting, allowed better-informed permitting decisions. Notification of constituents of improved floodplain information is part of the protocol for these recent mapping studies. Both the District and property owners can make decisions that decrease flood risk to safety and property.

Tanque Verde Creek can convey large amounts of flow. The Agua Caliente 2,200 (+/-) foot long soil cement levee is located on along the western embankment of the upstream of the Tanque Verde Road Bridge. The Agua Caliente spur dike is not a levee but had to pass many of the FEMA levee criteria in order for them not to map the floodplain as if the spur dike failed. It is located upstream of Tanque Verde Road along east embankment of the Agua Caliente Wash. The southern portion of the spur dike, adjacent to the channel, is soil cement. On the northern end, the structure bends to the east and becomes an earthen embankment with armoring. There is one flap gate upstream of the bridge

There are stream gauges at Chiva (ALERT ID# 2073), Tanque Verde Guest Ranch (ALERT ID# 2093), Tanque Verde Road (ALERT ID# 2109), and Sabino Canyon Road (ALERT ID# 2123). There is no bank protection upstream of Tanque Verde Road. The primary concern with higher discharges is overbank flooding resulting from high levels of flow. Locations of concern include 49's Country Club that the District has identified as a Repetitive Loss Area and the Woodland Road area. The District estimates initial breakout at 49er's to occur at 8,000 – 9,000 cfs. The district estimates initial breakout at Woodland Road at 13,000 – 15,000 cfs. The full report; Flood Hazard and Early Warning Analysis Tanque Verde Creek, includes inundation maps. Flows in the Tanque Verde that are a result of combined flows from the Tanque Verde Creek, Agua Caliente Wash, and Monument Wash impacts this area.

Impacted at-grade crossings include Wentworth Road and Tanque Verde Loop Road. At 200 cfs the COT Street Maintenance Division is contacted. Streamflow of 5,000 cfs at Chiva Tank (2073) or streamflow of 8,000 cfs at Tanque Verde Guest Ranch (2093) may affect 49's area or Woodland Road area. At these rates, senior staff decides whether to notify OEM. Due to sediment deposition near the gauge, judgment is required on the part of the Storm Monitor.

Large flows in Sabino Creek may affect numerous road crossings in the recreation area and some residential access and structures downstream of the USFS boundary. Lower flows are likely to overtop driveway access to some residential structures below the Forest Service boundary. The stream gauge on this channel is located at the dam in the US Forest Service (USFS) recreation area. No at-grade Crossings below the National Forest boundary are impacted. At streamflow of 2,000 cfs and flood stage of 3.4 feet at Sabino Canyon Dam (ALERT ID# 2163) residences in Sabino floodplain may be impacted and therefore senior staff decides whether to notify OEM.

5.4.11.5 Needs – Capital Improvement

For each watershed; monitoring, frequently flooded structures and properties subject to damage, exposed infrastructure, and safety concerns have been described in full detail in the District's Flood Response Field Manual (April 2019). Each of the areas so identified have addresses and geodetic coordinates associated with them and District personnel have them mapped in the Geographic Information System used. For planning purposes, specific items of concern follow; the complete report is in Appendix D.

Data Gathering Needs

- No site-specific issues identified.

Frequently Flooded Structures and Properties Subject to Damage

- Woodland Wash and other area channels do not have enough capacity to convey the base flood. (T13S R15E Sec. 23) <GIS Point ID: SAB-FSP-001>
- 3591 N. Bear Canyon Road (114-27-4380) (T13S R15E Sec. 27) <GIS Point ID: SAB- FSP-002>
- 3537 N. Camino Seco (114-28-015D) (T13S R15E Sec. 28) <GIS Point ID: SAB-FSP- 003>
- 3720 N. Camino Seco (114-27-445C) - Repetitive Loss Property, with claims in 1993 and 1999. (T13S R15E Sec. 27) <GIS Point ID: SAB-FSP-004>
- 8525 E. Cloud Road (114-28-016B) (T13S R15E Sec. 28) <GIS Point ID: SAB-FSP-005>
- 4575 N. Palisade Drive (114-19-010U) (T13S R15E Sec. 22) <GIS Point ID: SAB-FSP- 006>
- 4830 N. Hidden Valley Road (114-12-083A) (T13S R15E Sec. 16) <GIS Point ID: SAB- FSP-007>
- There are erosion concerns on Sabino Creek near Cloud Road (T13S R15E Sec. 28) <GIS Point ID: SAB-FSP-008>
- Springs may appear and septic systems may be adversely affected after significant moisture and/or sustained flows along the eastern Santa Catalina mountain front. (T13S R15E Sec. 13-16, T13S R16E Sec. 16-18) <SAB-FSP-009>

Infrastructure

- Snyder Road is potentially subject to damage along the eastern portion of the Santa Catalina mountain front. Snyder Road is also roughly the breakline between steep slopes and shallower slopes, and is an area of concern with respect to sediment deposition filling channels and causing flows to take unpredictable and uncertain flow paths. (T13S R15E Sec. 14) <SAB-INF-001>

Safety Concerns

- Rio Vista Drive conveys flow. (T13S R15E Sec. 23) <GIS Point ID: SAB-SAF-001>
- A wall along the west side of Houghton Road blocks flow. (T13S R15E Sec. 14) <GIS Point ID: SAB-SAF-002>
- This area contains numerous wash crossings that may become impassable. Paved crossings are subject to flood damage and may be severely damaged. Snyder Road between Harrison Rd. and Soldier Trail is particularly problematic. (T13S R15E Sec. 24) <GIS Point ID: SAB-SAF-003>
- Woodland Wash crosses Harrison road and Bear Canyon Road over at-grade crossings that are hazardous. (T13S R15E Sec. 22) <GIS Point ID: SAB-SAF-004>

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5.4.11.6 Floodplain Management

Future needs identified by District staff include:

- Riparian preservation
- Shallow groundwater
- High value unprotected property
- Cumulative Improvements to non-conforming uses
- Bank reclamation
- Warning System Outreach

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